

Virginia Water Resources Research Center Annual Technical Report FY 2015

Introduction

The Virginia Water Resources Research Center (VWRRC) was established at Virginia Tech in 1965 as a federally authorized program. In 1982, the Virginia General Assembly authorized the VWRRC as a state agency under the Code of Virginia (§23-135.7:8). In 2005, the VWRRC became an administrative unit in the College of Natural Resources and Environment at Virginia Tech.

Mission

The VWRRC provides research and educational opportunities to future water scientists; promotes research on practical solutions to water resources problems; and facilitates timely transfer of water resources information to policy- and decision-makers and the general public.

Mission Elements

Research

1. Assisting university researchers in securing research support funds from public and private sources to address water resources issues.
2. Assisting university researchers in initiating and executing water resources research.
3. Conducting research on water resources issues appropriate for expertise of personnel affiliated with the VWRRC.

Education

Advancing educational opportunities for students in water resources fields by

1. Helping university researchers provide undergraduate and graduate research experiences in water resources.
2. Coordinating an undergraduate minor and graduate certificate in water resources at Virginia Tech.
3. Coordinating a multidisciplinary undergraduate B.S. degree program in *Water: Resources, Policy, and Management* (WRPM) at Virginia Tech.
4. Connecting students in water resources fields with internship opportunities.

Outreach

1. Maintaining and frequently updating the VWRRC website and social media outlets to provide access to information on water resources science, engineering, and policy.
2. Publishing Virginia Water Central, a newsletter featuring articles on water-related policy and law, summaries of water conditions in Virginia, and news briefs about water issues.
3. Producing Virginia Water Radio, a weekly radio show and podcast featuring unique perspectives on water sounds and news and information involving Virginia's waters.
4. Securing academic advisors to work in an advisory capacity with public and private sectors as requested.
5. Initiating and participating in development and execution of seminars, conferences, and symposia on Virginia, regional, and national water issues.

Program Administration

Administrative oversight of the VWRRC is provided by the Dean of the College of Natural Resources and Environment. A Statewide Advisory Board appointed by the Governor advises the VWRRC director on state water research and information priorities. Because of its multiple legislative authorities and administrative responsibilities, the VWRRC has a number of reporting requirements. In addition to the annual reporting requirements to the USGS, it presents an annual report to the Virginia Tech administration and the College of Natural Resources and Environment. Three-year reports are presented to the USGS. Five-year reports are presented to the State Council on Higher Education for Virginia (SCHEV).

National Affiliations

The VWRRC is affiliated with NIWR and the Universities Council on Water Resources (UCOWR).

Programs of the VWRRC

Introduction

Programs are structured to meet strategic goals of the VWRRC and are consistent with the VWRRC mission as authorized by the U.S. Congress through the Water Resources Research Act of 1984 (Public Law 98-242), and Code of Virginia (§23-135.7:8). Programs in research and education are available to students and faculty at all Virginia colleges and universities. Outreach and collaborative programs include information transfer to policy/decision makers and citizens, and collaborative partnerships with state and federal agencies and other water-interest groups.

A. Research Programs

1. The VWRRC's statewide competitive grants program for students provides research funds to find practical solutions to water problems in Virginia and the region. The grant period begins June 1 and ends May 31 of the following year. Proposals are evaluated with emphasis on intellectual merit, innovation, likelihood of success, broader impacts on Virginians, and alignment with state or regional water resources needs and challenges. A priority listing of water research needs for this competitive grants program is updated annually in consultation with the VWRRC Statewide Advisory Board. These grants are designed to support research efforts with a high potential for expanded funding from additional sources.
2. The VWRRC applies for external grants and conducts in-house research.
3. The VWRRC facilitates research team building and interdisciplinary, multi-institute collaborative research.
4. The VWRRC facilitates research opportunities to other university faculty and external contractors through a partnership with federal agencies that provides targeted funding from the USGS.

B. Educational Programs

1. The VWRRC provides research opportunities to undergraduate students and assistantships to graduate students who participate in sponsored research. Also, numerous graduate and undergraduate students are supported through the VWRRC's competitive grants program in Virginia Tech academic departments, and at Virginia's other colleges and universities.
2. In 1999, the VWRRC established the William R. Walker Graduate Research Fellowship to honor the many contributions of Dr. William R. Walker, the VWRRC's first director. The annual monetary award is intended for individuals preparing for a professional career in water resources and is provided to at least one new graduate student at Virginia Tech each year. Details of the program can be found on the VWRRC website: http://www.vwrrc.vt.edu/walker_fellowship.html.

3. The VWRRC coordinates the interdisciplinary Watershed Management Undergraduate Minor and a Watershed Management Graduate Certificate Program in collaboration with five colleges and ten departments at Virginia Tech. The VWRRC also developed and coordinates an interdisciplinary B.S. degree program called *Water: Resources, Policy, and Management* (WRPM) in collaboration with the Department of Forest Resources and Environmental Conservation at Virginia Tech and nine other departments across five colleges. The VWRRC also coordinates two Sustainable Water Scholarships and two Sustainable Water Research Fellowships as part of the WRPM B.S. program.
4. Beginning in 2015, the VWRRC developed an internship program that provides an opportunity for an undergraduate student to assist with projects and sponsored research associated with the VWRRC.
5. The VWRRC supports and advises the Virginia Tech Chapter of the American Water Resources Association

C. Outreach and Collaborative Programs

1. The VWRRC provides administrative support for the Virginia Water Monitoring Council.
2. The VWRRC publishes research reports, symposia proceedings, and citizen education booklets. It provides funding for the publication of outreach efforts.
3. The VWRRC publishes a newsletter, *Virginia Water Central*, several times each year. It features scientific and educational articles, legislative information, and water news of interest. The newsletter is available to the public at <http://www.vwrcc.vt.edu/watercentral.html> and electronic copies are provided via email to more than 600 people.
4. The VWRRC sponsors or co-sponsors symposia, workshops, and seminars addressing contemporary water resources issues.
5. The VWRRC facilitates peer reviews for state programs when requested.
6. The VWRRC website (<http://www.vwrcc.vt.edu/>) serves as a repository of the Center's publications, houses an academic expert database, provides updated news and information relevant to water resources, and manages website links for collaborative partners, including the Virginia Water Monitoring Council, and the Virginia Department of Environmental Quality Stormwater BMP Clearinghouse. A news feed from the website allows users to subscribe to VWRRC updates via email.
7. The VWRRC has Twitter and Facebook sites and a Water News Grouper blog (<http://vawatercentralnewsgrouper.wordpress.com/>) to facilitate information exchange related to water resources and related news at the VWRRC.

Research Program Introduction

Research Program

The research program of the Virginia Water Resources Research Center (VWRRC) is supported through

1. its annual appropriation from the Commonwealth of Virginia,
2. external funding through grants and contracts, and
3. a portion of overhead generated by external funding.

The VWRRC's 104B funds are not allocated to support research, but are used to support its outreach and information dissemination programs and to provide administrative support.

Through its annual appropriation from the Commonwealth of Virginia, the VWRRC funded four new research projects during the reporting period through allocation of \$5,000 seed grants to graduate students at Virginia Tech in the Departments of Geosciences, Forest Resources and Environmental Conservation, and Biological Sciences, and at the Virginia Institute of Marine Science in the Department of Physical Sciences.

One research project that passed through USGS to the VWRRC was administered by the VWRRC and was active during the reporting period.

External funding during the reporting period totaled \$171,610, supported nine new and ongoing projects, ten graduate students, one post-doctoral research associate, and eight undergraduate students.

Development of Dynamic Gridding Tools for the USGS MODFLOW? USG Computer Program for Simulating Groundwater Flow"

Basic Information

Title:	Development of Dynamic Gridding Tools for the USGS MODFLOW? USG Computer Program for Simulating Groundwater Flow"
Project Number:	2014VA176S
USGS Grant Number:	
Sponsoring Agency:	USGS
Start Date:	9/22/2015
End Date:	9/21/2016
Funding Source:	104S
Congressional District:	VA-008
Research Category:	Ground-water Flow and Transport
Focus Category:	None, None, None
Descriptors:	None
Principal Investigators:	JyhMing Lien

Publications

There are no publications.

*Development of Methods for Simulating Flow and Transport
in Aquifers with Complex Geometrics*

A PhD student at George Mason University (GMU), Guilin Liu, is hired to work on this project as a Graduate Research Assistant (GRA) under the guidance of the PI Jyh-Ming Lien. During the reporting period, GMU and the U.S. Geological Survey (USGS) have joint effort to continue the development of gridding tools for the USGS MODFLOW-USG computer program. The team developed software tools to model and create unstructured grids for representing three-dimensional subsurface hydrogeology. These tools can perform GIS intersections of two-dimensional features, such as points, lines, and polygons with these grids. These tools allow users to create advanced hydrogeologic structures in both 2D and 3D and allow users to define the behavior of the top/bottom values of a grid. The GRA also focused on computer programming tasks using the C++ programming language and the development of data structures and algorithms in software tools designed specifically for the MODFLOW-USG computer program currently under development by the USGS.

Information Transfer Program Introduction

The VWRRC supports timely dissemination of science-based information to policy- and decision-making entities and to citizens. The VWRRC used its USGS 104B funds to support expert personnel with responsibilities related to the VWRRC's outreach and collaborative programs. USGS 104B funds were not used to support the VWRRC's research program. During the reporting period, the USGS 104B funds supported:

1. Preparation and electronic publication of the newsletter *Virginia Water Central*.
2. Partial administrative support for the Virginia Water Monitoring Council.
3. Partial support for production and management of the VWRRC webpage, VWRRC Facebook, VWRRC Twitter, and Virginia Water Radio.
4. Preparation and electronic publication of the *Virginia Water Central* Water News Grouper containing annotated links to articles and references relevant to Virginia's water resources. The Water News Grouper is accessed via the VWRRC webpage (<http://vawatercentralnewsgrouper.wordpress.com>).

Information Transfer

Basic Information

Title:	Information Transfer
Project Number:	2015VA177B
Start Date:	3/1/2015
End Date:	2/29/2016
Funding Source:	104B
Congressional District:	Ninth
Research Category:	Not Applicable
Focus Category:	None, None, None
Descriptors:	None
Principal Investigators:	Stephen H. Schoenholtz

Publications

1. Garey, A.L., G.C. Garman, and L.A. Smock. 2015. Development of aquatic life use assessment protocols for Class VII waters in Virginia: 2015 Report of the Academic Advisory Committee for Virginia Department of Environmental Quality. Publication of the Virginia Water Resources Research Center, Blacksburg, VA., 19 pp.
2. Smith, E.P. 2015. Using single sample information to evaluate criteria for waterbody health risk: 2015 Report of the Academic Advisory Committee for Virginia Department of Environmental Quality. Publication of the Virginia Water Resources Research Center, Blacksburg, VA., 17 pp.
3. Virginia Water Central, September 2015 (No. 64), 40pp.
4. Ali, G., Tetzlaff, D., McDonnell, J.J., Soulsby, C., Carey, S. Laudon, H., McGuire, K., Buttle, J., Seibert, J., Shanley, J., 2015. Comparison of threshold hydrologic response across northern catchments, *Hydrological Processes*, 29(16): 3575-3591, doi: 10.1002/hyp.10527.
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10. Cohen, M.J., Creed, I., Alexander, L., Basu, N., Calhoun, A., Craft, C., D'Amico, E., DeKeyser, E.,

- Fowler, L., Golden, H., Jawitz, J., Kalla, P., Kirkman, K., Lane, C., Lang, M., Leibowitz, S., Lewis, D., Marton, J., McLaughlin, D.L., Mushet, D., Rannan-Kiperwas, H., Rains, M., Smith, L., Walls, S. 2016. Do geographically isolated wetlands influence landscape functions? *Proceedings of the National Academy Sciences* 113(8): 1978-1986, doi: 10.1073/pnas.1512650113.
11. Creed, I.F., McKnight, D.M., Pellerin, B.A., Green, M.B., Bergamaschi, B.A., Aiken, G.R., Burns, D.A., Findlay, S.E.G., Shanley, J.B., Striegl, R.G., Aulenbach, B.T., Clow, D.W., Laudon, H., McGlynn, B.L., McGuire, K.J., Smith, R.A., Stackpoole, S.M., 2015. The river as a chemostat: fresh perspectives on dissolved organic matter flowing down the river continuum, *Canadian Journal of Fisheries and Aquatic Sciences*, 72(8): 1272-1285, doi: 10.1139/cjfas-2014-0400.
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15. Juran, L., Trivedi, J. 2015. Women, gender norms, and natural disasters in Bangladesh. *Geographical Review*, 105(4), 601-611.
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Information Transfer

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Outreach and Information Transfer Accomplishments

Newsletter *Virginia Water Central*

Email distribution to approximately 600 recipients and announcement/availability on VWRRC Web site.

Notifications to *Virginia Water Monitoring Council List Serv*

The VWRRC provides administrative support to the Virginia Water Monitoring Council (VWMC). The VWMC was formed to promote and facilitate coordination of water monitoring programs throughout the Commonwealth of Virginia. Membership in the VWMC is open to any person or organization with responsibility for or interest in water monitoring in Virginia. Weekly water-related announcements via list serve are provided to 650 members (representing more than 250 different organizations) of the VWMC. Announcements include information about conferences, workshops, total maximum daily load (TMDL) public meetings in Virginia, job openings, newly published reports, information posted on Web sites, and other pertinent information.

1. Distributed 38 sets of general announcements (450 individual announcements) as e-mail messages to the VWMC membership; each message contained at least a dozen informational announcements, including: calls for papers, conference announcements, job openings, training opportunities, recently published reports, information posted on websites, total maximum daily load (TMDL) public meetings in Virginia, and other pertinent information.
2. Developed 16 sets of special announcements and distributed these as e-mail messages to the VWMC membership for a total of 130 unique announcements; these announcements pertained to VWMC-sponsored activities, information about beach-monitoring and water recreation as specified in grants from the Virginia Department of Health (VDH), job opportunities, stormwater management training opportunities, and upcoming conferences.
3. Collaborated with VDH to develop special beach monitoring announcements for distribution to the VWMC membership and beyond.
4. Weekly announcements are posted on the VWMC's website www.vwrrc.vt.edu/vwmc.

VWRRC Website

(www.vwrrc.vt.edu)

The VWRRC website is updated at least weekly and supports a Water News Grouper blog page, which is updated several times each week. During the reporting cycle there were approximately 200 posts listed on the Water News Grouper blog page, approximately 8116 page views (22/day) and approximately 6200 site visits (17/day). The VWRRC website also serves as the portal for two other websites that the VWRRC manages:

1. Virginia Water Monitoring Council (<http://www.vwrrc.vt.edu/vwmc/default.asp>)
2. Virginia Department of Environmental Quality Stormwater BMP Clearinghouse (<http://www.vwrrc.vt.edu/swc/>)

VWRRC is on **Twitter** at <http://twitter.com/VaWaterCenter> and **Facebook** (<http://www.facebook.com/pages/Blacksburg-VA/Virginia-Water-Resources-Research-Center/186479556264?v=wall>)

Virginia Water Radio

(www.viriniawaterradio.org)

The VWRRC produces and hosts a weekly 5-minute radio show featuring summaries of recent water news, upcoming water events, and water-related sounds or music. The radio show also includes relevance to specific Virginia science and social studies Standards of Learning for Virginia public schools for each episode. Virginia Water Radio is broadcast on three campus stations: WECH at Emory & Henry College, WUVT at Virginia Tech, and WVRU at Radford University. During the past year 52 episodes were produced and the Water Radio Web site had about 3,000 page views (about 9 per day) and about 1,700 site visits (about 5 per day).

Virginia Water Monitoring Council 2015 Annual Conference

The VWRRC helped to organize the VWMC 2015 annual conference, held November 19, 2015 at the Henrico County Training Center in Henrico, VA. The theme of the conference was “Exploring Emerging Water Issues.” Mark Bennett, Director of the USGS Virginia/West Virginia Water Science Center gave the keynote address. Eight other invited speakers gave presentations to more than 110 participants.

The VWRRC created the VWMC conference website and promoted the conference to the VWMC membership and the Center's conference mailing list. Following the VWMC conference, the VWRRC posted the presentation slides on the VWMC website: <http://www.vwmc.vwrrc.vt.edu/conference/>. The VWRRC also coordinated the payment of bills associated with the conference.

2015 Mid-Atlantic Volunteer Water Monitoring Conference

This conference was designed to foster a stronger relationship among volunteer water monitors and state and federal agencies. The VWRRC supported the conference through its work with the VWMC, which was one of the conference sponsors. Other sponsors included the U.S. Environmental Protection Agency, Virginia Department of Environmental Quality (DEQ), Virginia Citizens for Water Quality, Friends of the Shenandoah, and Shenandoah University.

About 120 individuals attended the conference, which was held August 6-8, 2015 at Shenandoah University in Winchester, VA. The theme of the conference was "Bridging the Water Quality Data Gap." Keynote addresses were given by representatives of DEQ and the Chesapeake Bay Program. The program included 20 invited speakers, two field trips, and six workshops.

VWRRC personnel served on the conference planning committee, promoted the conference through the VWMC website and email notifications, and recruited speakers from the VWMC membership to present on the various desired topics.

2015 Water Resources Conference of the Virginias

The VWRRC partnered with the West Virginia Water Research Institute to host a regional conference, held October 5-6, 2015 at the Stonewall Resort in Roanoke, WV. The theme of the conference was "Water/Energy/Agriculture." The conference included 5 keynote speakers, 35 oral presentations, and 17 poster presentations. More than 120 attended the conference.

VWRRC personnel served on the conference planning committee, solicited invited speakers and sponsors, promoted the conference through our mailing lists, moderated a session, and performed other tasks as needed to ensure the conference ran smoothly.

2016 National Institutes for Water Resources (NIWR) Annual Meeting

The state water resources research institutes (WRRIs) are organized as the National Institutes for Water Resources (NIWR). As president elect of NIWR, the VWRRC's director, Dr. Stephen Schoenholtz, was responsible for organizing this year's annual meeting. The meeting was held February 8-10, 2016 at the Hotel George in Washington, D.C. About 70 individuals registered for the meeting. The event included board meetings, a business meeting, and visits with legislators on Capitol Hill. There was a breakfast to welcome new directors and opportunities to interact with representatives from USGS and other federal agencies. The program included a panel discussion on water challenges and opportunities from the perspective of federal programs. Virginia Representative Rob Wittman gave a presentation on water from a federal legislative perspective. Thirteen WRII directors or staff members gave 5-minute presentations to share programs and processes that have enhanced the WRII program in their state.

VWRRC personnel worked in partnership with Van Scoyoc Associates on the logistics of the meeting. The VWRRC developed the meeting website, handled the registration, planned the program in conjunction with other NIWR partners, invited speakers, and performed other tasks as needed to ensure the meeting ran smoothly.

International Outreach Activities

1. VWRRC Faculty serve as referees for numerous international journals.
2. Associate Director McGuire serves as Associate Editor of *Hydrological Processes*, an international journal, and *Journal of Environmental Quality*, which publishes international research.
3. Associate Director McGuire is North American chair for the international Gordon Research Conference on Catchment Science.
4. Director Schoenholtz serves as sub-editor of *Current Forestry Reports*, an international journal.
5. Assistant Professor Juran organized and delivered five workshops on water quality and post-point contamination in India.
6. Director Schoenholtz collaborated with water colleagues at the International Center for Agribusiness Research and Education (ICARE) at Armenian National Agrarian University in Armenia to receive a grant to ICARE from USAID's Partnerships for Enhanced Engagement in Research program to research water quality and quantity for fisheries in Armenia.

USGS Summer Intern Program

Basic Information

Start Date:	6/1/2014
End Date:	12/31/2015
Sponsor:	Office of Surface Water
Mentors:	Harry Jenter
Students:	Gregory Petrochenkov

Internship Evaluation

Question	Score
Utilization of your knowledge and experience	Good
Technical interaction with USGS scientists	Good
Treatment by USGS as member of a team	Very Good
Exposure and access to scientific equipment	Good
Learning Experience	Very Good
Travel	About Right
Field Experience Provided	About Right
Overall Rating	A

Additional Remarks

This was a great experience overall. Everyone I worked with was very helpful!

Basic Information

Start Date:	6/17/2014
End Date:	12/31/2015
Sponsor:	Office of Surface Water
Mentors:	Harry Jenter
Students:	Christopher Mazzullo

Internship Evaluation

Question	Score
Utilization of your knowledge and experience	Very Good
Technical interaction with USGS scientists	Good
Treatment by USGS as member of a team	Acceptable
Exposure and access to scientific equipment	Good
Learning Experience	Very Good
Travel	About Right
Field Experience Provided	About Right
Overall Rating	A

Additional Remarks

Student Support					
Category	Section 104 Base Grant	Section 104 NCGP Award	NIWR-USGS Internship	Supplemental Awards	Total
Undergraduate	0	0	2	8	10
Masters	0	0	0	2	2
Ph.D.	0	0	0	8	8
Post-Doc.	0	0	0	1	1
Total	0	0	2	19	21

Notable Awards and Achievements

The new interdisciplinary B.S. degree in *Water: Resources, Policy, and Management* at Virginia Tech had first cohort of students enroll in August 2015. The VWRRC coordinates curriculum and advising for this new degree. See <http://waterdegree.frec.vt.edu/> for more information.

Director Stephen Schoenholtz was elected to the President-Elect position in NIWR effective October, 2015.

The VWRRC organized the 2016 annual meeting of NIWR in February, 2016.

The VWRRC co-organized (with West Virginia Water Research Institute) the *2015 Water Resources Conference of the Virginias* in October, 2015.

The VWRRC supported four student interns, three undergraduate students, ten graduate students, and one post-doctoral research associate during the reporting period.

University Council on Water Resources website feature on new B.S. degree in *Water: Resources, Policy, and Management*.

Completed four radio episodes on water resources for National Public Radio's *Pulse of the Planet*.

Published 27 peer-reviewed manuscripts and reports.